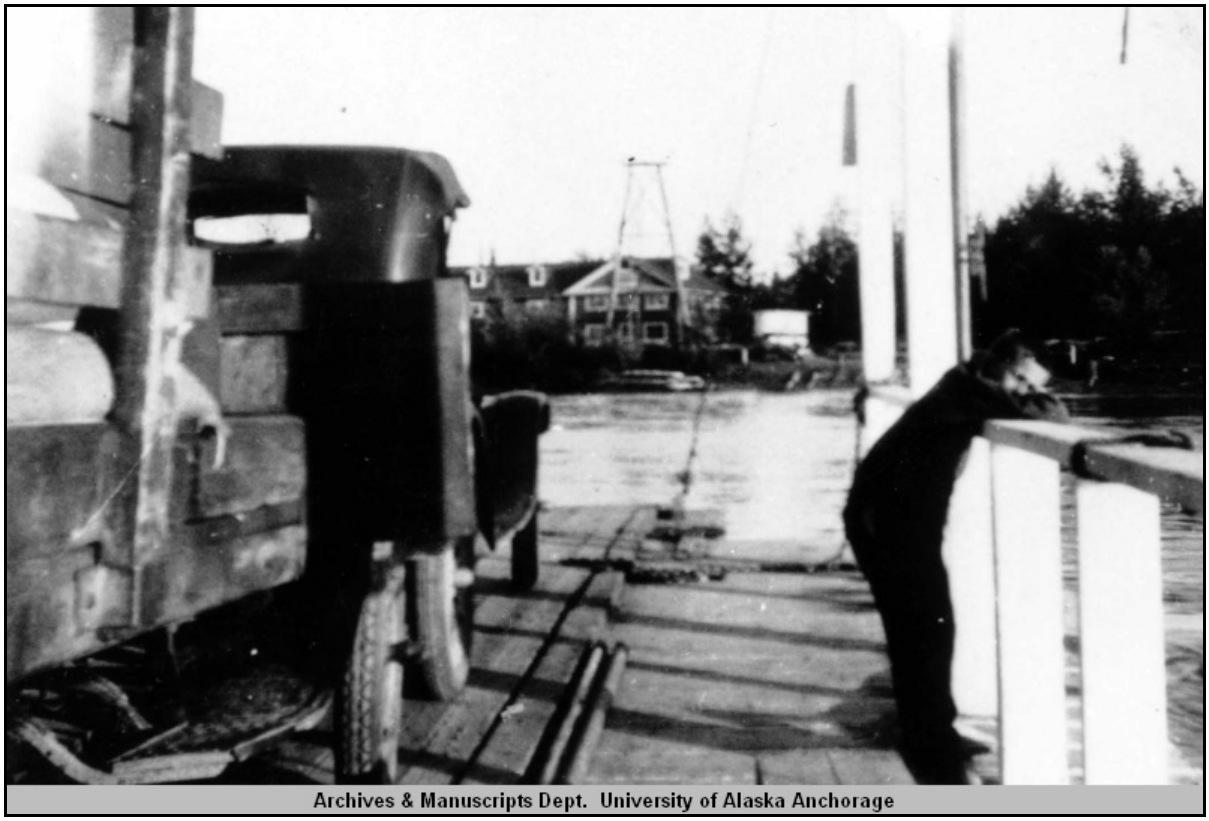
BIG DELTA STATE HISTORICAL PARK
RIVERBANK RESTORATION FEASIBILITY STUDY

Revision 0

Prepared For
ECI / Hyer, Inc., Anchorage, Alaska

By
Christopher H. Roach P.E., Consulting Engineer
April 2005



Ferry Crossing at Rika's Landing, 1928

Rika's Roadhouse – A Discussion on Bank Protection Alternatives

Table of Contents

Rika's Roadhouse – A Discussion on Bank Protection Alternatives

Prepared For U.S. Fish and Wildlife Service
Fairbanks Fish and Wildlife Field Office

By

Christopher H. Roach P.E., Consulting Engineer

November 2004

Introduction and Background

This paper presents a preliminary discussion of bank protection alternatives at Rika's Roadhouse that would minimize the use of in-stream structures. Follow up data collection would be necessary to confirm the observations and alternatives presented here, as well as to refine the geometry and placement of bank protection measures. The narrative style of this report provides a brief overview of issues and alternatives in order to allow a rapid turnaround as requested by the U.S. Fish and Wildlife Service (Service).

Rika's roadhouse and landing is located on the left bank of the Tanana River upstream of the Richardson Highway and Trans Alaska Pipeline bridges (references to right and left bank are oriented looking downstream). Figure 1 provides an overview of the site. Rika's is the site of the Big Delta State Historical Park owned by the Department of Natural Resources. A plan is currently under consideration to construct a series of in-stream rock barbs for bank protection at Rika's. The barbs would occupy an area on the stream bed measuring approximately 24 ft wide by 65 ft long and projecting out away from the bank at an angle of approximately 45 degrees. Some concerns have been expressed that placing these structures in the stream bed would result in an unacceptable loss of in-stream spawning habitat for fall chum salmon (ADF&G Sport Fishery Division, ADF&G Commercial Fishery Division, ADNR Habitat Division, and the Service). Due to these concerns, the Service requested an assessment of bank erosion protection alternatives that would minimize the use of in-stream structures.

A field visit was conducted on October 28, 2004 with the following personnel:

- Elaine Mayer, Fairbanks Fish and Wildlife Field Office
- Christopher H. Roach P.E, Consulting Engineer
- Nancy Ihlenfeldt, ADNR Office of Habitat Management and Permitting
- Kevin Boeck, ADF& G Commercial Fisheries
- Larry Lysne, Fairbanks Fish and Wildlife Field Office
- Robert Henzey, Fairbanks Fish and Wildlife Field Office

A follow up meeting was conducted on October 29, 2004 to discuss the site conditions and alternatives available for providing stream bank protection while minimizing the use of in-stream structures. In addition to the individuals listed above, the following personnel were also present:

- Mac McLean, ADNR Office of Habitat Management & Permitting
- Larry Bright, USFWS Fairbanks Project Branch Chief
- Jim Fish, ADF&G Sport Fishery Division
- John Hilsinger, ADF&G Commercial Fishery Research Supervisor
- Bonnie Borbe, ADF&G Commercial Fisheries

Several previous studies and assessments have been developed for the Tanana River in this reach and at Rika's Roadhouse. These reports and documents provide additional background information, flow data, and alternatives considered. Summarizing these studies is beyond the scope of this discussion. A partial list of previous reports and studies is listed below:

- Tanana River at Big Delta, Bridge 524 Hydraulic Survey, August 26-28, 1996, USGS, Fairbanks, Alaska.
- Stream Bank Erosion and Alternative Protection Plans, Rika's Roadhouse and Landing Big Delta State Historical Park, Dr. R.F. Carlson, University of Alaska, Fairbanks 1998
- Big Delta State Historical Park Bank Stabilization Project. USDA Natural Resources Conservation Service (bank erosion plan currently under consideration, and associated EA dated January 2004).

Site Conditions

The site is located on the left bank of the Tanana River on a mild right bend upstream of the Richardson Highway and Trans Alaska Pipeline, Figure 1. The river is bounded by relatively high banks within this reach and has a braided channel morphology at Rika's. The reach directly in front of Rika's has developed a minor cove with a shallow shelf extending out into the stream bed. This shelf has active spring flows which are important to the viability of spawning beds within this reach. At the time of the site visit active spawning was ongoing within this reach. A small parcel of private land is located downstream, and adjacent to, the Rika's property. Downstream of this private parcel, the banks appear to be in a natural state with no evidence of clearing or disturbance of riparian vegetation, representing the condition of the banks and riparian vegetation prior to clearing and removal of vegetation.

Active bank erosion was evident at several locations within the reach of the Rika's Roadhouse property. Bank erosion appeared to be most severe at the private property immediately downstream of the site and in front of the Ferryman's Cabin, Figure 4 and 5. According to the January 2004 EA, the 1997 and 1998 seasons resulted in notable bank erosion. Long term rates of bank erosion have not been determined (but could be developed from careful review of aerial photography and historic records/information). The banks

immediately upstream and downstream of the reach at Rika's appear to be relatively stable. In particular, no evidence of recent bank erosion was visible in the undisturbed reach downstream of the private property, Figure 2. This observation supports the theory that the magnitude and distribution bank erosion is directly related to clearing of vegetation, ongoing vegetation maintenance practices, and foot traffic along the upper bank. A detailed discussion of these observations follows, proceeding from downstream to upstream.

- ***Downstream of private property (downstream of Rika's):***

  The left bank appears to be undisturbed in this reach, with no evidence of any vegetation clearing, Figure 2. No recent bank erosion was visible. Several mature trees within this reach are growing out diagonally from the bank, with the upper 10 to 12 feet of the tree turning vertically. This indicates that, at some time in the past, the bank slumped, but the trees and other vegetation have continued growing and the bank has been stable for many years. A number of mature birch, cottonwood, and spruce trees are located in this reach, and the bank is covered by dense vegetation.

  Two distinct zones are evident on the bank within this reach: The zone above Ordinary High Water (OHW) characterized by stable vegetation and a bank height of approximately 5 feet (the bank above OHW is likely composed of silts stabilized by vegetation); and the zone below OHW, characterized by a distinct shallow angle transition to the stream bed which is composed of gravel and cobbles. This transition zone defines the "toe" of the upper bank. This distinction will be important in the discussion of observed bank erosion to follow.

- ***Private property downstream of Rika's***

  A distinct change in vegetation is evident compared with the reach immediately downstream, Figure 3 and 4. It is clear that a significant amount of vegetation has been removed from the upper bank. This section of riverbank exhibits the most severe land loss of the entire section that was evaluated, with bank erosion on the order of 20 feet or more in at least two locations. The "toe" of the slope, which is comprised of gravels and cobbles transitioning into the stream bed, appears to be relatively unchanged compared to the downstream reach (i.e., virtually all of the land loss occurred above OHW where bank vegetation has been removed, while the toe of the slope does not appear to be moving).

- ***Downstream section of Rika's property***

  This includes the "Ferryman's cabin", boat launch, and the bank downstream of the "riprap point" discussed below, Figure 5. Similar to the private property downstream, a distinct change in vegetation is evident compared with the downstream stable reach. Changes in vegetation include a significant reduction in vegetation density, the near absence of mature trees, and a change in vegetation species. Recent bank erosion and land loss was evident, with several distinct failures of the bank above OHW clearly visible. The toe of the slope below OHW appears to be relatively unchanged (i.e., virtually all of the land loss occurred above OHW and the toe of the slope does not appear to be moving).

- ***Riprap protected "point" in front of Rika's Roadhouse Building***

  A small point in front of Rika's was armored in the 1950's with riprap (according to ADNR/USFWS discussions with the concessionaire historian), Figure 6. This riprap is still present and appears to be stable even though it is of marginal quality. The slope shows no evidence of recent movement. A relatively deep scour hole has developed at the base of the riprap slope, and limited riprap appears to remain at the toe of the slope near the pool. The top of the riprap is at approximately the OHW elevation. Above OHW the bank appears to be relatively stable. The upper bank has several mature trees. It appears that the vegetation on the upper bank has been selectively thinned, possibly to promote growth of wild roses and a view of the river in front of the Rika's Roadhouse building.

- ***Cove and shallow shelf upstream of Rika's Roadhouse Building***

  This reach is characterized by some bank erosion above OHW and a relatively stable toe/ stream bed below OHW. A log crib ferry landing that was installed in the early 1900's is still well intact, Figure 7. A historic log boat dock structure (or possibly the remnant of a bridge abutment) downstream of the ferry landing is the site of an overbank disposal site where grass clippings and other vegetation is deposited. No significant loss of the toe of the slope was evident throughout this reach, indicating that while bank erosion is occurring, it is primarily above OHW. Disturbance to the vegetation above OHW is evident throughout this reach. An overflow from the duck pond drains over the bank in this reach and has obvious bank erosion occurring at the outfall. This area also has the highest density and volume of spring flow discharging from the bank in addition to extensive artesian upwelling across the shallow stream bed shelf.

- ***"Point" upstream of Rika's Roadhouse Building***

  This point is characterized by a high upper bank with a steep gravel/cobble slope below OHW, Figure 8. Some failure of the upper bank is evident above OHW, with a few large blocks separated from the upper bank. The angle of the slope below OHW is approximately 1h:1v and is much steeper than any other location (downstream) described previously. The slope below OHW is comprised of cobbles with some gravel. Large cobbles are distributed throughout the base (toe) of the slope. The cobbles at the toe of the slope are covered with a heavy growth of algae, indicating that, in all likelihood, the toe of the slope is not being eroded rapidly but rather it is remaining relatively stable.

- ***Upstream of "Point"***

  The bank appears to be relatively stable upstream of the point. Within a small alcove upstream of the point, it is in a depositional phase, as discussed above, with several feet of recent silt deposition. This indicates that rapid bank erosion is not occurring, either above or below OHW. Rather, deposition of silt at and above OHW indicates that this reach is in a depositional phase. The alcove is the site of an overbank disposal site where grass clippings and other vegetation is deposited.

- ***General observation***

  Recent evidence of clearing bank vegetation was visible throughout the reach. In addition, at least two locations on the bank are being used for disposing of grass clippings, vegetation cleared from the banks, and other organic debris.

Based on these observations, it is apparent that the reach adjacent to Rika's has a composite bank with silts and organic soils above OWH and a gravel/cobble slope transitioning into the stream bed below OHW. It appears that the majority of the land loss at Rika's was associated with changes in vegetation from clearing. This led to the soils above OHW becoming unstable, with subsequent failure of the bank. The slope below OHW appears to be relatively stable. The contribution of foot traffic on the upper bank stability and the influence of disposal of organic debris over the bank is unclear, but is likely also a contributing factor in the observed bank erosion patterns.

Discussion of Alternatives

With the preceding discussion on site conditions, alternatives are presented here for bank erosion protection. The objectives of these alternatives include:

- Minimize the use of in-stream structures to protect spawning beds.
- Develop a strategy that directly addresses the observed bank erosion mechanisms.
- Provide for detection of future bank movement in the gravel/cobble slopes below OHW.
- Provide for flexibility to take action in the future as necessary to protect the toe of the slope below OHW if unacceptable movement is detected.

Restoring the vegetation and bank stability above Ordinary High Water will provide significant strides in re-establishing the integrity of the bank throughout this reach. Observed bank erosion was predominantly above OHW and was likely the result of past and continued vegetation clearing, foot traffic, and changes in vegetation type. Restoring the integrity of the upper bank would require a tailored approach to address the changes in bank height, soils, historic riparian vegetation community, vegetation remaining, relative degree of bank instability, and historic land loss throughout the reach, as described below:

- In areas with significant land loss, such as the downstream reach on Rika's near the Ferryman's cabin and boat launch, this would involve excavating down to the OWH elevation and reconstructing the bank using soil wraps, coir logs, willow brush layering, and revegetation of the re-constructed bench. The advantage of this approach is that the historic bank line can be restored (i.e. restore the bank out to near the 1998 position, thereby regaining some of the land that was lost to bank erosion since that time), which would allow an increased buffer to be established between existing structures and the new edge of bank. The new bank should be designed and constructed to be flexible to allow some minor settlement to occur without failure of the bank, which would accommodate minor changes in the toe of the slope below OHW. Some additional information will be needed to determine the proper soil mix

for backfill of the soil wraps. The bank appears to be primarily composed of silt, and the composition of the backfill may require mixing in granular material and organics to promote vegetation re-growth while minimizing build up of pore pressure within the bank soil matrix following floods.

- In areas with minor erosion, this may involve a variety of techniques to stabilize the bank in place and allow the existing vegetation to regenerate. Some of these techniques are described in the handbook entitled *Streambank Revegetation and Protection, a guide for Alaska (Muhlberg and Moore, 1998)* Techniques may include:
    - Placing coir logs (anchored into the bank) to provide minor protection against entrainment and transport of soils at the base of the upper soil layer. Coir logs would likely be used in conjunction with willow bundles.
    - Placing willow bundles to the bank where minor erosion has occurred in order to rapidly increase vegetation coverage and rooting density.
    - Placing biodegradable Geofabric over exposed soils and re-seeding to provide rapid surface erosion protection with grass.
- In areas with no active bank erosion, changes in vegetation management would reduce the risk of future bank erosion from occurring (i.e. minimize or cease further vegetation clearing).
- The effluent from the duck pond should be drained through an outfall designed to eliminate surface flow over the bank and allow free draining through the bank. This would prevent buildup of excess pore pressure within the bank and would improve the integrity of the bank at that location. This would correct the observed bank erosion at the duck pond overflow.

One key factor in the long term stability of the soils above OHW will be the stability and rate of movement of the toe of the slope (cobbles and gravel) below OHW. If the streambed / toe of the slope below OHW erodes then the upper part of the slope could be undermined. Thus, a monitoring program should be put in place to assess the long term rates of movement of the toe of the slope below OHW throughout the reach. This will allow detection of movement of the bank below OHW and will provide a clear understanding of where toe erosion may be occurring, as well as the magnitude and rate of movement. An annual monitoring plan to re-survey several key locations along the reach should also include an assessment of changes in vegetation management and whether continued vegetation clearing along the bank is occurring.

If it is determined that the toe of the slope is subject to active erosion, then additional measures could be taken to stabilize the toe of the slope below OHW. These measures would involve placement of structures to increase the erosion resistance of the toe of the slope as well as to reduce hydraulic demand by reducing shear stress and flow velocity in the near bank region. Structures to consider may include:

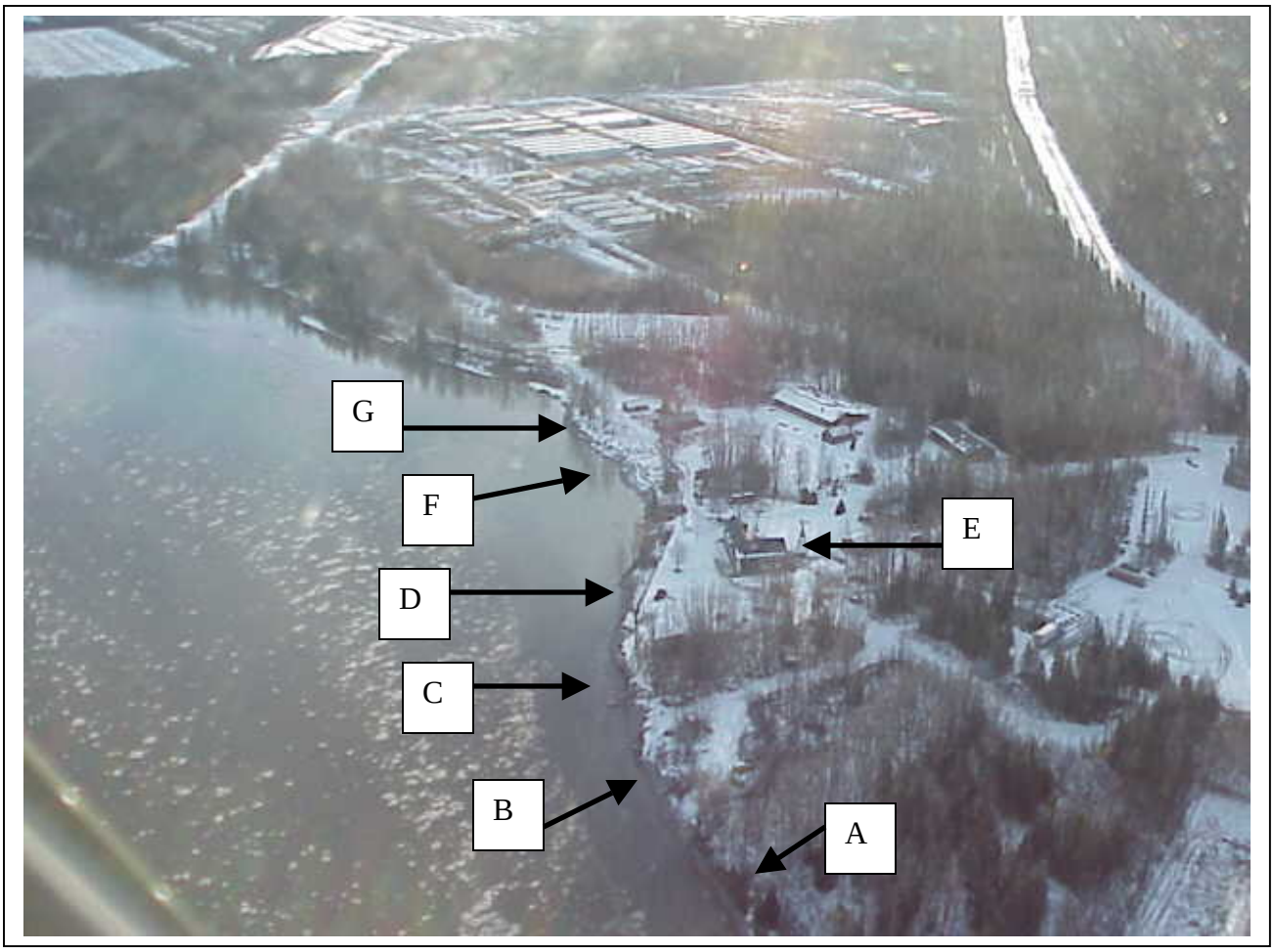
- Root wad revetment. A root wad revetment at the upstream section of the property, starting in the alcove upstream of the "point" (upstream of Rika's Roadhouse Building), may be useful to stabilize the toe of the slope and form a bench to buttress the upper slope. The length of a root wad revetment structure would be limited, only as necessary to protect the lower bank at this point from erosion.
- Riprap toe protection. This may be appropriate at the "point" in front of the Rika's Roadhouse Building which was protected in the 1950's with riprap. This slope has riprap up to approximately the OHW elevation and some loss of riprap may have occurred at the toe of the slope. A limited amount of riprap toe protection at the base of this slope would increase the stability of the upper slope. It is possible to place the riprap from above the bank using a track hoe, thus minimizing disturbance in this area. This may also be appropriate at the "point" upstream of the Rika's Roadhouse Building, at the toe of the steep slope below OHW, in lieu of the root wad revetment.
- Rock vanes (and possibly log vanes). Rock vanes point upstream at an angle of approximately 15 to 20 degrees away from the bank and slope into the bed at a slope of approximately 2% to 5%. Rock vanes are constructed of large boulders placed using a track hoe. They have an advantage, over in-stream barbs, in that they occupy a width of approximately 4 to 5 ft (compared with up to 25 ft), thus limiting the impact on in-stream spawning habitat. Vane structures reduce velocity and shear stress near the banks, thus providing erosion protection.

Control of foot traffic will minimize trampling of bank vegetation and allow the re-vegetation effort to succeed, see Figure 9 for an example of a footpath directly along the bank which is having a negative impact on bank vegetation. In order to facilitate this, foot paths that are set back away from the bank should be developed (some are already in place). Boardwalks or platforms at viewing areas could be installed at discrete locations along the bank to allow for viewing the river while maintaining the integrity of the bank vegetation.

Monitoring of the bank to determine erosion rates would involve establishing several monumented cross section locations along the property that could be re-surveyed annually. The annual survey would be best completed in the fall after water levels have receded. Toe pins would be placed in the stream bed at the toe of the slope. The toe pins allow an accurate means of measuring the bank position. This approach would allow data from each year to be overlain and compared to develop an accurate understanding of long term erosion rates, and where that erosion may be occurring. An annual monitoring plan should also include a review of vegetation management practices and management practices for controlling foot traffic on the bank. The future integrity of the bank will rely heavily on maintaining a strong riparian vegetation community so cutting and thinning of the vegetation should be carefully managed.

Summary

The approach described here for providing bank protection at the Rika's Roadhouse property involves restoring and maintaining the vegetation and integrity of the upper bank while monitoring the lower bank to determine future erosion rates. Limited use of use of structural controls such as root wad revetments, rock vanes, and riprap toe protection could then be prescribed as necessary to address specific locations where loss of the lower slope is actively occurring. This does carry some increased risk compared with an approach which would immediately stabilize the lower slope. Currently the highest risk of bank erosion is likely the point upstream of the Rika's Roadhouse Building, due to the exposed nature of the bank and due to the angle of attack from the channel. The consequence of bank erosion at that location should be evaluated and discussed if this plan is advanced. Given current river conditions, risks to the other locations along the reach with this approach, once completed, will be the same as the risk of bank erosion at an undisturbed well vegetated low bank such as the location downstream of the private property. It is judged that the risk of future erosion at the shallow shelf, near where the duck pond drains out and near the log crib ferry landing, will be minimal once the integrity of the upper bank is restored. This plan minimizes the placement of in-stream structures and directly addresses the observed mechanism of active bank erosion. It provides a staged approach to restoring the integrity of the bank while protecting valuable in-stream spawning habitat for fall chum salmon. In order to advance this plan, the next steps would involve a careful survey of the site to develop detailed repair alternatives for specific locations.



Point A: Stable bank downstream of private property (downstream of Rika's property)
Point B: Private property downstream of Rika's property
Point C: Boat launch, lower section of Rika's property in front of Ferryman's cabin
Point D: Point in front of Rika's Roadhouse Building
Point E: Rika's Roadhouse Building
Point F: Alcove upstream of Rika's Roadhouse Building with shallow shelf and log crib ferry dock structure
Point G: Point upstream of Rika's Roadhouse Building

Figure 1: Aerial oblique photo, looking upstream at Rika's Roadhouse Property

Figure 2: Looking downstream at stable bank with undisturbed vegetation. Note density of vegetation, prevalence of mature trees, and lack of any recent bank erosion

Figure 3: View looking upstream from same location as Figure 2, showing change in vegetation and active bank erosion at private property.

Figure 4: Looking downstream from Rika's Roadhouse boat dock at private property and stable bank beyond. Note contrast in vegetation from upstream to downstream and associated bank erosion above OHW.

Figure 5: Active bank erosion of upper bank in front of Ferryman's Cabin

Figure 6: View of "Riprap Point" in front of Rika's Roadhouse Building.

Figure 7: Log crib ferry dock structure Located upstream of Rika's Roadhouse Building in alcove (see Figure 1 Point F)

Figure 8: Point upstream of Rika's Roadhouse Building (foreground) and stable upstream bank beyond (see Figure 1 Point G for location of upstream point)

Figure 9: View of stairway leading down to boat dock. Note location of foot path and lack of vegetation of upper bank